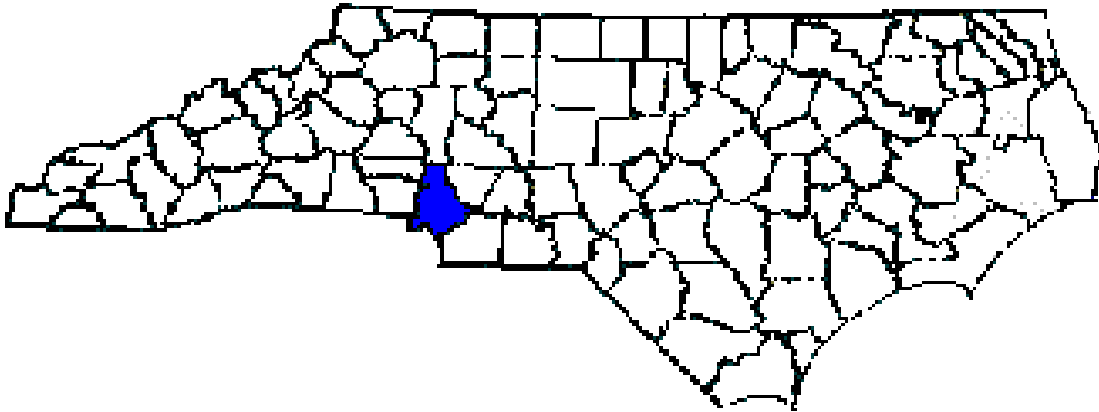


ANNUAL REPORT FOR 2008



**Unnamed Tributaries to Doby Creek Mitigation Site
Mecklenburg County
TIP No. I-3803A**



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SUMMARY

The following report summarizes the stream monitoring activities that have occurred during the Year 2008 at the Unnamed Tributaries to Doby Creek (UT to Doby Creek) Mitigation Site in Mecklenburg County. This site was constructed during 2005 by the North Carolina Department of Transportation (NCDOT). This report provides the monitoring results for the third formal year of monitoring (Year 2008). The Year 2008 monitoring period was the third of five scheduled years for monitoring on UT to Doby Creek (See Success Criteria Section 2.1).

Based on the overall conclusions of monitoring along UT to Doby Creek, it has met the required monitoring protocols for the third formal year of monitoring. The channel is stable throughout the stream at this time. The stream bank and buffer area is highly vegetated for the third year of monitoring. The North Carolina Department of Transportation will continue stream monitoring at the UT to Doby Creek Mitigation Site for 2009.

1.0 INTRODUCTION

1.1 Project Description

The following report summarizes the stream monitoring activities that have occurred during the Year 2008 at the UT to Doby Creek Mitigation Site. The site is located adjacent to the southbound I-85 lanes at the US 29/49 interchange in Charlotte (Figure 1). The UT to Doby Creek Mitigation Site was constructed to provide mitigation for stream impacts associated with Transportation Improvement Program (TIP) number I-3803A in Mecklenburg County.

The mitigation project covers approximately 220 linear feet along the perennial reach and 347 linear feet along the intermittent reach. Construction was completed during 2005 by the North Carolina Department of Transportation (NCDOT). Stream restoration involved the removal of 152 linear feet of culvert along the perennial reach and 170 linear feet of culvert along the intermittent reach. The restoration also involved, new channel construction along both reaches, widening the floodplain to allow for major flood events, and the installation of cross vanes and coir fiber logs. Coir fiber matting was installed on the stream bank. Live stakes and bareroot seedlings were planted along the stream bank and in the floodplain.

1.2 Purpose

In order for a mitigation site to be considered successful, the site must meet the success criteria. This report details the monitoring in 2008 at the UT to Doby Creek Mitigation Site. Hydrologic monitoring was not required for the site.

1.3 Project History

March 2005	Construction Completed.
March 2005	Planted Live Stakes and Bareroot Seedlings
August 2006	Vegetation Monitoring (1 yr.)
October 2006	Stream Channel Monitoring (1 yr.)
September 2007	Stream Channel and Vegetation Monitoring (2 yr.)
September 2008	Stream Channel and Vegetation Monitoring (3 yr.)

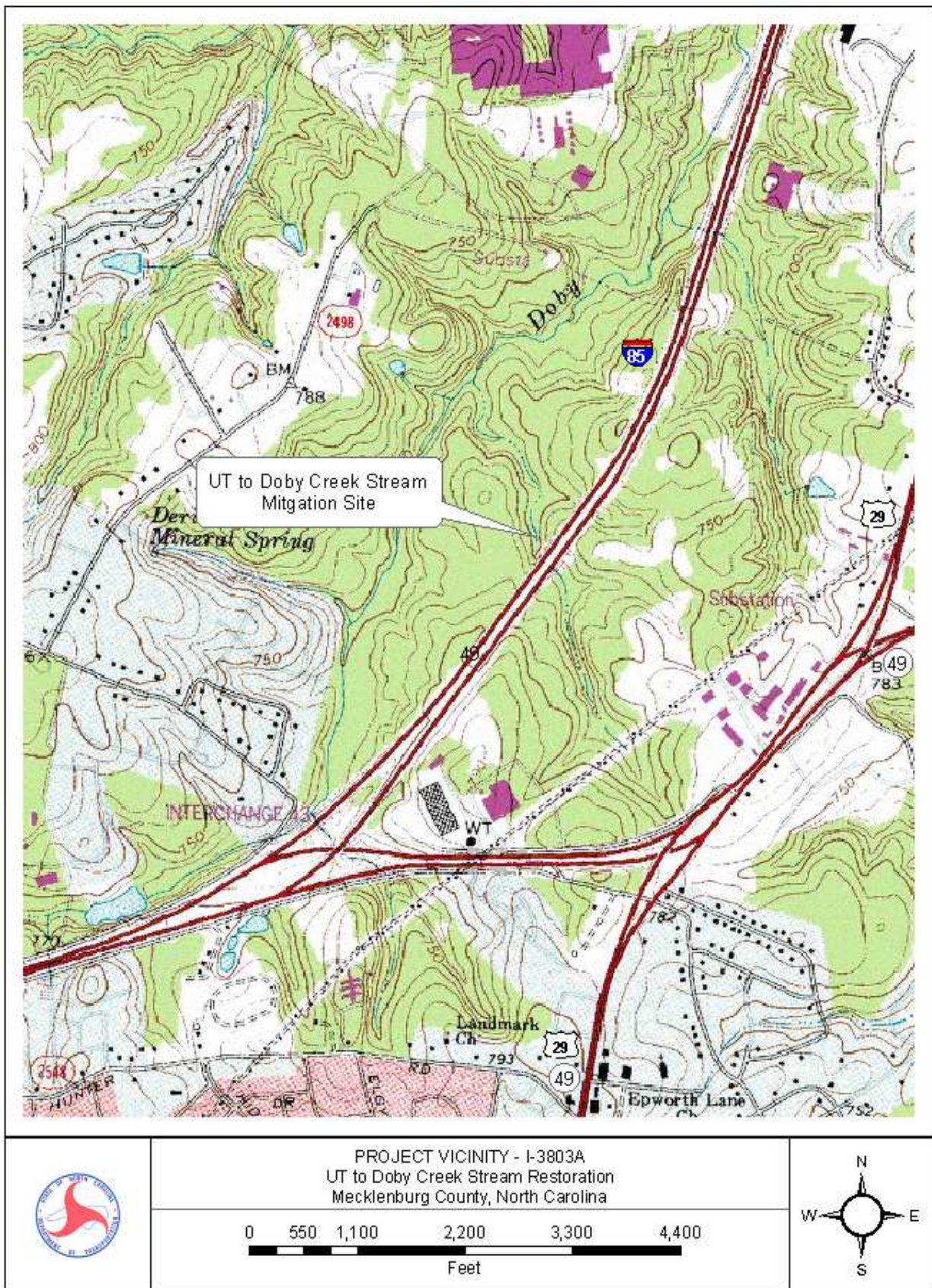


Figure 1. Vicinity Map

2.0 STREAM ASSESSMENT

2.1 Success Criteria

The following activities were conducted on the perennial reach. The intermittent reach will only be photographed yearly.

Cross-sections

Permanent cross-sections (either surveyed or located using GPS) will be established at a spacing of one per 20 bankfull-width lengths. Each cross-section will be marked on both banks with permanent pins to establish the exact transect used. The annual cross-section survey will include points measured at all breaks in slope, including top of bank, bankfull, inner berm, edge of water, and thalweg. Calculations will be made of width/depth ratio, entrenchment ratio, and low bank height ratio.

Pattern

Annual measurements taken for the plan view of the restoration site will include sinuosity, meander width ratio, and radius of curvature (on newly constructed meanders only for the first year of monitoring)

Materials

Annual pebble counts will be performed on all gravel-bed project reaches based on the percent of pools and riffles.

Longitudinal Profile

A complete longitudinal profile will be completed during the first year and then every two years for a total of five years (a total of 3 profiles). Measurements will include slope (average, pool, riffle) and pool-to-pool spacing. Survey points will include thalweg, water surface, inner berm, bankfull, and top of low bank. Each of these points will be taken at the head of each feature, e.g. riffle, run, pool, glide, and max pool depth.

Bank Erosion Estimates

A bank erodibility hazard index (BEHI) score will be made. An estimate of near-bank shear stress will be made by measuring the water surface slope along the observed bank length, as well as for the entire feature length, following the thalweg. Bank erosion estimates should be less than 0.1 yd³/year.

Photo Reference

Digital photographs should be taken along the perennial and intermittent reaches at permanent photo locations on an annual basis. Photographs should include photos of permanent cross-section locations, in-stream structure, success of vegetation, and any changes in the stream channel.

Survival Plots

Survival of planted vegetation will be evaluated using survival plots or counts. Survival of live stakes will be evaluated using enough plots or a size plot that allows evaluating at least 100 live stakes. Evaluations of live stake survival will continue for at least 5 years. When stakes do not survive a determination will be made as to the need for replacement; in general if greater than 25% die replacement will be done.

Bare root vegetation will be evaluated using at least 2 staked survival plots. Plots will be 50 ft. by 50 ft. and all flagged stems will be counted in those plots. Success will be defined as 320 stems per acre after 5 years. When bareroot vegetation does not survive, a determination will be made as to the need for replacement; in general, if greater than 25% die, replacement will be done.

2.2 Stream Description

2.2.1 Post-Construction Conditions

The mitigation of UT to Doby Creek involved the removal of 152 linear feet of culvert along the perennial reach and 170 linear feet of culvert along the intermittent reach. The restoration also involved, new channel construction along both reaches, widening the floodplain to allow for major flood events, and the installation of cross vanes and coir fiber logs. Coir fiber matting was installed on the stream bank. Live stakes and bareroot seedlings were planted along the stream bank and in the floodplain.

2.2.2 Monitoring Conditions

The objective of the UT to Doby Creek stream restoration was to build an E5 stream as identified in the Rosgen's Applied River Morphology. A total of two cross sections (one in a riffle and one in a pool) were surveyed. For this report, only cross sections containing riffles were used in the comparison of channel morphology presented below in Table 1. Data shown in Table 1 includes one cross section chosen to represent a riffle section.

Variable						
	Proposed	2006	2007	2008	2009	2010
		Cross-Section #1	Cross-Section #1	Cross-Section #1		
Drainage Area (mi ²)	.25	.25	.25	.25		
Bankfull Width (ft)	11.0	11.32	11.55	11.6		
Bankfull Mean Depth (ft)	1.0	0.8	0.82	0.8		
Width/Depth Ratio	10.0	14.15	14.09	14		
Bankfull Cross Sectional Area (ft ²)	11.3	9.05	9.46	9.7		
Maximum Bankfull Depth (ft)	1.3	1.49	1.54	1.7		
Width of Floodprone Area (ft)	30-35	40.1	40.1	40.1		
Entrenchment Ratio	2.7-3.2	3.54	3.47	3.5		
Slope	0.024	0.0239	N/A	0.0206		

*Drainage Area, Floodprone Width, and Slope are averaged values only.

*Riffle values are used for classification purposes, pool values are shown in Appendix A.

Particle Sizes (Reach Count)	Proposed	2006	2007	2008	2009	2010
D ₁₆ (mm)	N/A	0.83	0.74	0.34		
D ₃₅ (mm)	N/A	1.67	1.64	0.59		
D ₅₀ (mm)	N/A	6.27	11.75	0.87		
D ₈₄ (mm)	N/A	19.85	22.19	10.31		
D ₉₅ (mm)	N/A	51.33	45	16		

2.3 Results of the Stream Assessment

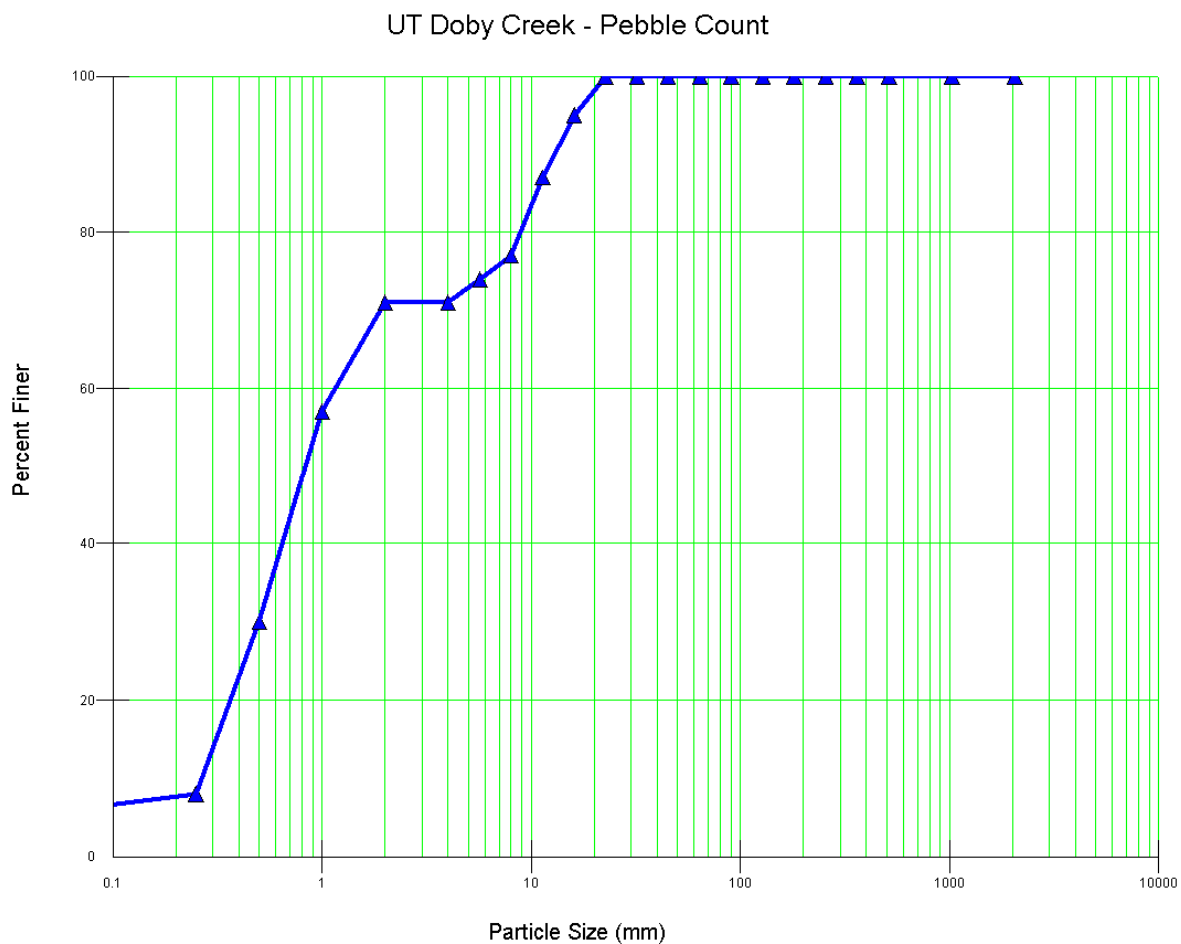
2.3.1 Site Data

The assessment included the survey of two cross sections and the longitudinal profile of UT to Doby Creek established by the NCDOT after construction. The length of the profile along UT to Doby Creek was approximately 200 linear feet. The longitudinal profile will only be completed during monitoring years 2006, 2008, and 2010 (See Success Criteria Section 2.1). Two cross sections were established during the 2006 monitoring year. Cross section locations were subsequently based on the stationing of the longitudinal profile and are presented below. The locations of the cross sections and longitudinal profiles are shown in Appendix A.

- ◆ Cross Section #1. UT to Doby Creek, Station 25.08 linear feet, midpoint of riffle
- ◆ Cross Section #2. UT to Doby Creek, Station 62.04 linear feet, midpoint of pool

Based on comparisons of 2007 to 2008 monitoring data, both cross sections appear stable with little or no active bank erosion. There was some aggradation noted on the graph for cross section #2 pool. This is due to sediment deposited into the channel from a drainage ditch on the fill slope. The drainage ditch has down cut but was stable at the time of monitoring. There was also evidence that a bankfull event had recently occurred on site. Graphs of the cross sections are presented in Appendix A. Future survey data will vary depending on actual location of rod placement and alignment, however, this information should remain similar in appearance.

A representative pebble count was taken throughout the surveyed reach. This information is used to determine the stream type. Pre-construction data was not available for UT to Doby Creek. The pebble counts taken during the Year 2007 and Year 2008 monitoring period noted that the D_{50} (50 percent of the sampled population is equal to or finer than the representative particle diameter) for the entire reach of UT to Doby Creek was approximately 11.75 mm and 0.87 mm respectively, which is indicative of a sand-bed stream. The D_{50} has decreased in size since 2007 because a drainage ditch on the fill slope has eroded and some sediment has washed into the channel. The drainage ditch has stabilized itself for now. The D_{50} has classified this channel as a sand-bed stream for 2008 due to the finer particles deposited into the channel. A chart depicting the particle size distributions for UT to Doby Creek for the Year 2008 is presented below.



A bank erodibility hazard index (BEHI) score was completed by evaluating different sections of the entire study reach. An estimate of near-bank shear stress (NBS) was made by measuring the water surface slope along the observed bank length, as well as for the entire feature length, following the thalweg. According to permit conditions, bank erosion estimates should be less than 0.1 yd³/year. All sections throughout the study reach resulted in a predicted erosion rate lower than 0.1 yd³/year. Overall, the reach is very stable with only minor areas of erosion present. The BEHI and NBS data are presented below:

Bank Erosion Prediction (BEHI)						
Station	Bankfull Height (ft)	Bank Height (ft)	Root Depth (ft)	Root Density (%)	Bank Angle	Surface Protection(%)
Sta. 35 to 50 LT. Bank	1	1	1	70	45	50
Sta. 73 to 86 LT. Bank	1	1	1	80	45	25
Sta. 96 to 106 RT. Bank	1	1	1	70	60	40
Sta. 143 to 154 RT. Bank	1	1	1	65	60	60
Total Bank Erosion Calculations		BEHI Numerical Rating	BEHI Adjective Rating	NBS Numerical Rating	NBS Adjective Rating	Predicted Erosion
Sta. 35 to 50 LT. Bank		12.2	Low	0.25	Very Low	0.01 yd ³ /year
Sta. 73 to 86 LT. Bank		13.6	Low	0.25	Very Low	0.01 yd ³ /year
Sta. 96 to 106 RT. Bank		13.7	Low	0.25	Very Low	0.01 yd ³ /year
Sta. 143 to 154 RT. Bank		12.5	Low	0.25	Very Low	0.01 yd ³ /year

2.4 Results of Stream and Buffer Vegetation

2.4.1 Description of Species

The following live stake species were planted on the stream bank:

Salix nigra, Black Willow

Cornus amomum, Silky Dogwood

The following tree species were planted in the buffer area:

Fraxinus pennsylvanica, Green Ash

Platanus occidentalis, Sycamore

Alnus serrulata, Tag Alder

Quercus phellos, Willow Oak

Betula nigra, River Birch

2.4.2 Results of Vegetation Monitoring

Stream bank Vegetation: One live stake plot was set to determine if the success criteria was being met.

Plot #	Black Willow	Silky Dogwood	Total (3 year)	Total (at planting)
1	26	74	100	100

Buffer Vegetation: Two vegetation plots were set to determine the trees per acre in the buffer area.

Plot #	Green Ash	Sycamore	Tag Alder	Willow Oak	River Birch	Total (3 year)	Total (at planting)	Density (Trees/Acre)
1	4	7	3	3	3	20	20	680
2	1	4	9	3	4	21	23	621
Average Density (Trees/Acre)								650

Site Notes: Other vegetation noted: *Juncus* sp., cattail, sedge, *Sagittaria* sp., woolgrass, jewelweed, goldenrod, fennel, red bud, and various grasses.

2.4.3 Conclusions

There was one live stake monitoring plot established along the stream bank. The 2008 live stake monitoring of the site revealed 100 live stakes were surviving within the plot. This meets the success criteria for year three monitoring.

There were two vegetation monitoring plots established throughout the buffer area. The 2008 vegetation monitoring of the site revealed an average tree density of 650 trees per acre. This average is well above the minimum success criteria of 320 trees per acre after year three monitoring.

3.0 OVERALL CONCLUSIONS/RECOMMENDATIONS

The UT to Doby Creek mitigation site has met the required monitoring protocols for the third formal year of monitoring. The channel and structures throughout the stream are stable at this time. The stream bank and buffer area is highly vegetated for the third year of monitoring. NCDOT will continue to monitor the UT to Doby Creek stream mitigation site in 2008.

4.0 REFERENCES

Unnamed Tributaries to Doby Creek. Mecklenberg, NC, April 9, 2003

I-85 Widening (From US 29/NC 49 to Speedway Blvd. State Project No. 8.1675102, TIP No. I-3803A, USACE Action ID 202231338 (For LPA, by Buck Engineering)

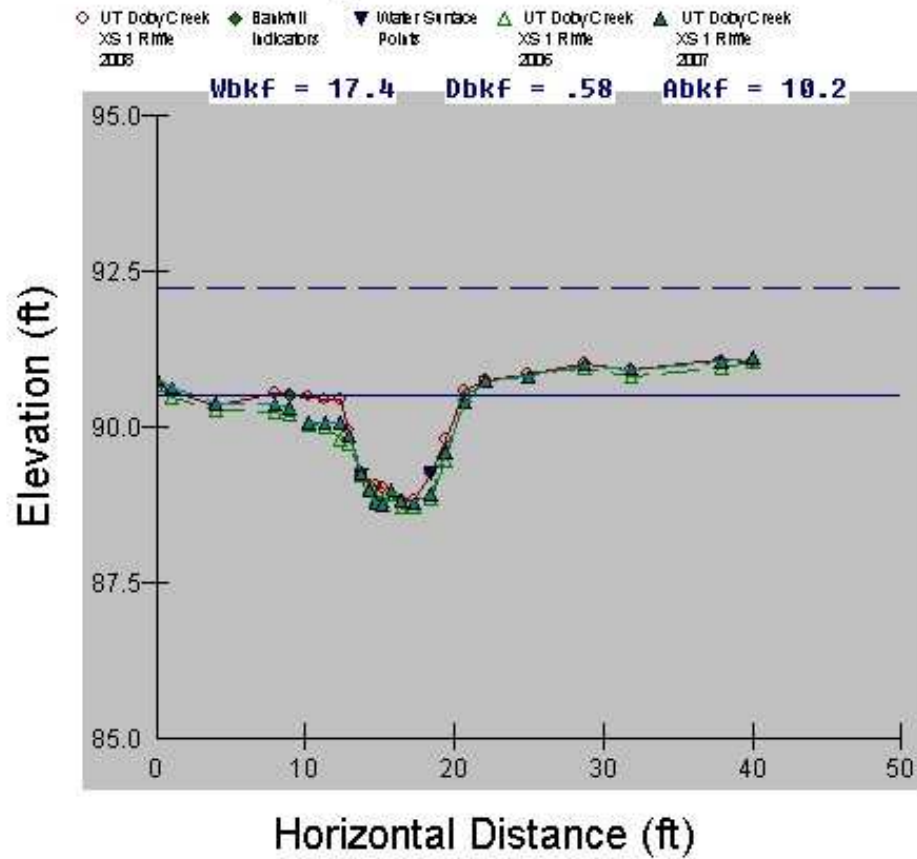
Rosgen, D.L, 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, Colorado.

US Army Corps of Engineers (USACE), 2003. Stream Mitigation Guidelines. Prepared with cooperation from the US Environmental Protection Agency, NC Wildlife Resources Commission, and the NC Division of Water Quality.

APPENDIX A

CROSS SECTIONS AND LONGITUDINAL PROFILE COMPARISON

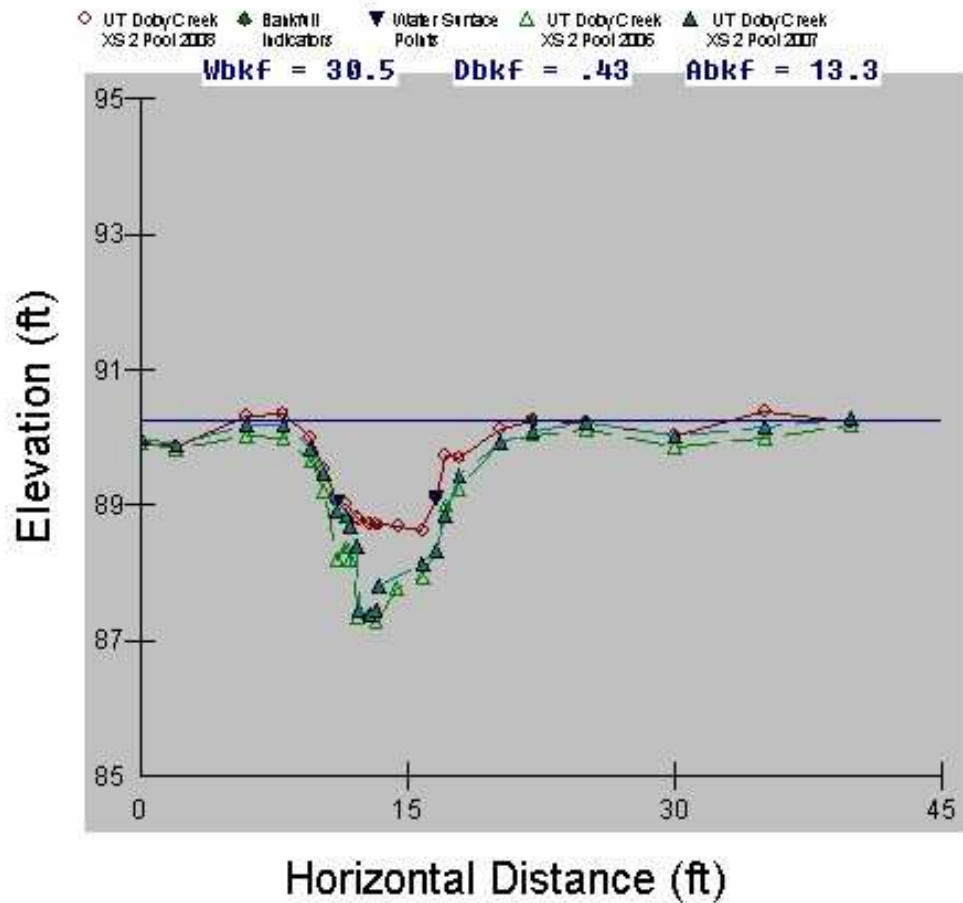
UT Doby Creek XS 1 Riffle



Cross-Section #1 (Riffle) Abbreviated Morphological Summary

	2006	2007	2008	2009	2010
Bankfull Cross Sectional Area (ft ²)	9.05	9.46	9.7		
Maximum Bankfull Depth (ft)	1.49	1.54	1.7		
Width of the Floodprone Area (ft)	40.1	40.1	40.1		
Bankfull Mean Depth (ft)	0.8	0.82	0.8		
Width/Depth Ratio	14.15	14.09	14		
Entrenchment Ratio	3.54	3.47	3.5		
Bankfull Width (ft)	11.32	11.55	11.6		

UT Doby Creek XS 2 Pool

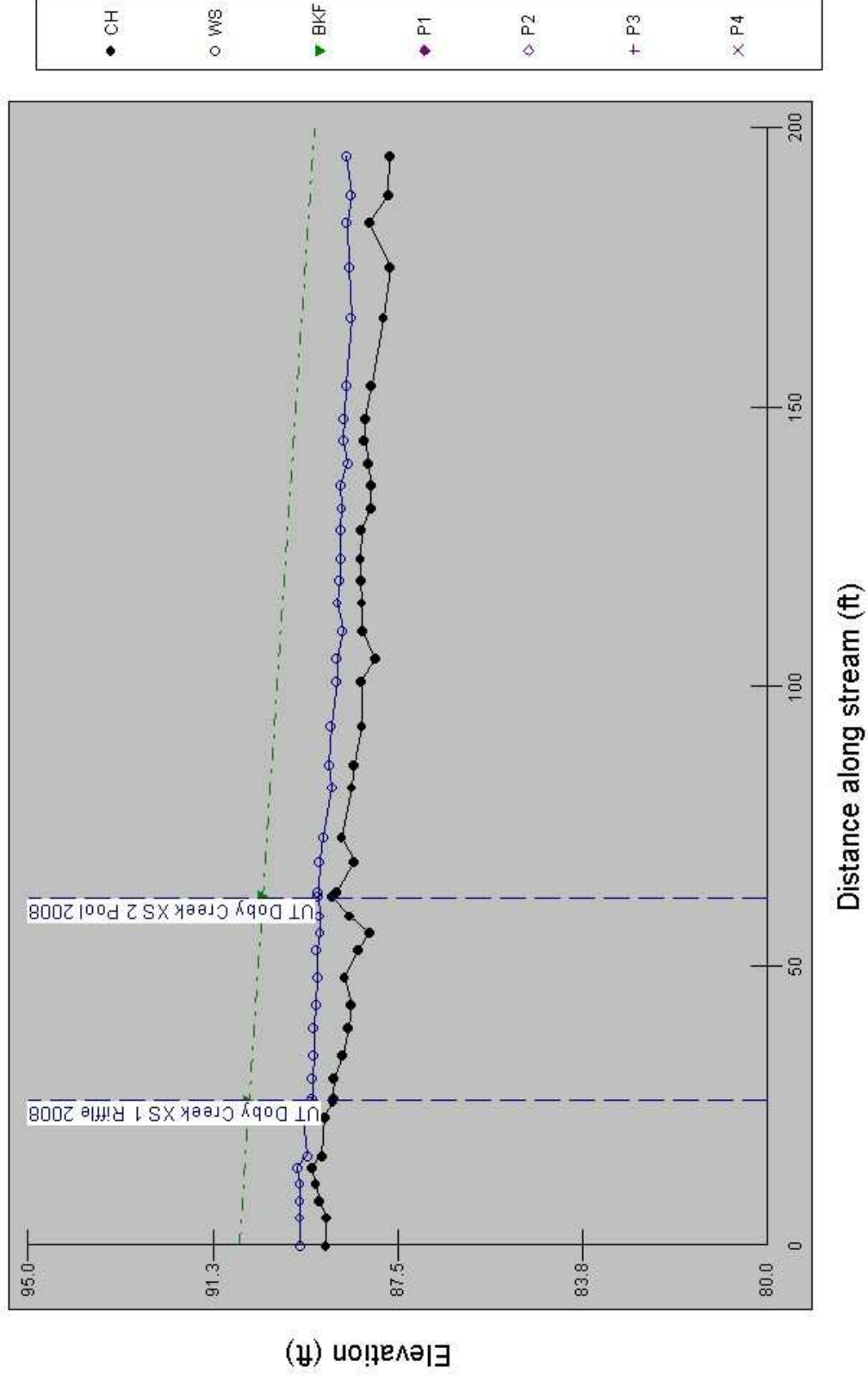


Cross-Section #2 (Pool) Abbreviated Morphological Summary*

	2006	2007	2008	2009	2010
Bankfull Cross Sectional Area (ft²)	16.85	15.09	11.01		
Maximum Bankfull Depth (ft)	2.75	2.7	1.62		
Bankfull Mean Depth (ft)	1.06	1.11	0.82		
Bankfull Width (ft)	15.85	13.63	13.5		

* According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width depth ratio are not measured in pool, glide, or run features.

UT Doby Creek



APPENDIX B

SITE PHOTOGRAPHS, CROSS SECTION AND

PHOTO POINT LOCATIONS

UT to Doby Creek

Perennial Reach



Photo Point #1 (Vegetation Plot 1)



Photo Point #1 (Vegetation Plot 1)



Photo Point #1 (Vegetation Plot 2)



Photo Point #2 (Upstream @ X-Section #1)



Photo Point #2 (Downstream @ X-Section #2)
September 2008



Photo Point #3 (Upstream)

UT to Doby Creek

Perennial Reach



Photo Point #3 (Downstream)

September 2008

UT to Doby Creek

Intermittent Reach



Photo Point #1 (Upstream)



Photo Point #1 (Downstream)



Photo Point #2 (Upstream)



Photo Point #2 (Downstream)



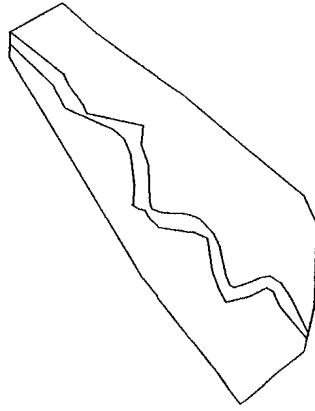
Photo Point #3 (Upstream)



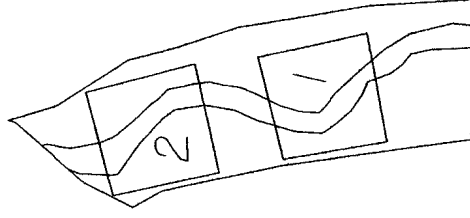
Photo Point #3 (Downstream)

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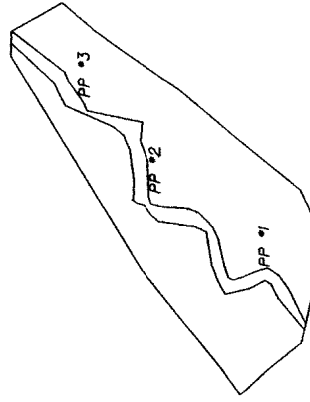
Intermittent Reach



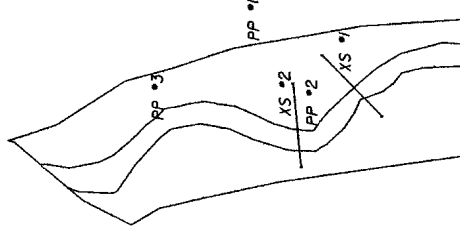
Perennial Reach

<div>1</div>	Tree and Live Stake Plot
<div>2</div>	Tree Plot

UT to Doby Creek 1-3803A



Intermittent Reach



Perennial Reach

Legend	
XS	- Cross Section
PP	- Photo Point